

REMARKS**1. Appendix A**

Appendix A following Remarks section of the present Office Action Response is a graphical illustration of the hydrogen storage material present Application along with graphical illustrations of the prior art cited by the Examiner. The figures depicted in Appendix A are meant to assist the Examiner by illustrating the differences between the cited prior art and the present application.

Amended Claims

Each claim containing the phrase "magnesium or magnesium based" has been amended to include only the shortened phrase "magnesium based." Applicant submits that this phrase has identical meaning to the previous phrase in that magnesium based alloys include those that contain only magnesium. Therefore, entry of the present amendment is respectfully requested.

Claim 1, 14, 15, 17, 18, 20 and 21 has been amended to claim magnesium based hydrogen storage alloy in the particulate form. No new matter has been added to claim 1 as claim 1 as claim 1 is supported by claim 1 as originally filed, Figure 1.

1. Rejections under 35 U.S.C. 112

The amended claims only recited magnesium-based hydrogen storage alloys. Therefore, removal of the rejection is respectfully requested.

2. Rejection of claims 1-2 and 13 under 35 U.S.C. 102(b) as being anticipated by Hjort et al. (Hydrogen sorption kinetics of partly oxidized Mg films)

Hjort teaches a uniform, continuous palladium film covering a magnesium film. However, Hjort does not teach a "magnesium-based hydrogen storage alloy which is in particulate form." as taught and claimed by the applicants. The difference in teachings between the present invention and the prior art are illustrated in Appendix I.

Applicants teach and claim a unique magnesium-based hydrogen storage material with a continuous or semi-continuous layer of catalyst material on a hydrogen storage alloy in particulate form. Applicants teach that this continuous or semi-continuous layer can be achieved through, for example, a coating process which includes evaporating the catalytic material to coat the hydrogen storage alloy, at a thickness of about 100 Angstrom (page 6, paragraph 58.) By providing this very thin coating of catalyst material on the hydrogen storage alloy, cohesion of the catalyst material is sufficiently weak to allow the catalyst material to be spread across the surface of an irregularly shaped particle, but the cohesion of the catalyst material is sufficiently strong to provide a continuous or semi-continuous layer. Applicants unique magnesium-based hydrogen storage material is not taught by a process in which a palladium film is taught in Hjort.

Since Hjort does not teach a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy particle, as required by Applicants' claim 1, claim 1 along with claims 2, 4-5, 13-15, and 17-22, which are dependent on claim 1, are not anticipated by Hjort. Thus, Applicants respectfully request withdrawal of the rejection.

3. Rejection of Claims 1-2, 4-5, 13-15, and 17-22 under 35 U.S.C. 102 (b) over Welter (US 4,613,362)

Welter does not teach a layer of catalytic material as taught and claimed by the applicants. Further, it would not have been obvious to one of ordinary skill in the art to modify the distribution (by using more or less iron) to achieve the desired catalytic effect because simply using a specific amount of iron Welter in the Welter process would not lead to Applicants claimed invention.

In contrast to Applicants' teachings, Welter teaches mixing large iron particles of 20 microns to 40 microns (200,000 to 400,000 Angstrom) with magnesium chips, and then compacting the mixture. (Welter, column 3, lines 30-32) Welter further teaches that these iron particles are homogenously distributed over the surface of magnesium granulate particles. (Welter, column 4, lines 21-22) As discussed in Welters, iron has very low solubility in magnesium. (Welters, column 2, lines 21-22) Forces that attract iron molecules to other iron molecules and forces that attract magnesium molecules to other magnesium molecules are much greater than the attractive forces between iron molecules and magnesium molecules. This difference in attraction levels results in the low solubility of iron in magnesium. Therefore, during a typical mixing and compacting process as taught by Welter, iron will not form a continuous or semi-continuous layer on magnesium, but rather, due to strong cohesive forces, iron will remain as large discrete particles. In fact, Welter only refers to iron particles and not layers (See Welter column 4, lines 21-22.) Therefore, simply using "more or less iron" would not lead to Applicants claimed invention

Applicants teach and claim a unique magnesium-based hydrogen storage material with a continuous or semi-continuous layer of catalyst material on the hydrogen storage alloy. Applicants teach that this continuous or semi-continuous layer can be achieved through, for example, a coating process which includes evaporating the catalytic material to coat the hydrogen storage alloy at a thickness of about 100 Angstrom (page 6, paragraph 58.) By providing this very thin coating of catalyst material on the hydrogen storage alloy, cohesion of the catalyst material is sufficiently weak to allow the catalyst material to be spread across the surface of the hydrogen storage alloy, but the cohesion of the catalyst material is sufficiently strong to provide a continuous or semi-continuous layer.

Since Welter does not teach a continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy in particulate form, as required by Applicants' claim 1, along with claims 2, 4-5, 13-15, and 17-22, which are dependent on claim 1, are not anticipated by Welter. Thus, Applicants respectfully request withdrawal of the rejection.

4. Rejection of Claims 1, 4-9, 13-15, 17-22 under 35 U.S.C. 103 (a) over Hu et al. (*Preparation and hydriding/dehydriding properties of mechanically milled Mg-30 wt% TiMn_{1.5} composite*)

Applicants traverse the Examiner's rejection over Hu, because Hu does not teach a magnesium-based hydrogen storage material in which form a continuous or semi-continuous layer as required by claim.

By finely dispersed particles do not constitute a continuous or semi-continuous coating, that is a material at a thickness that coats or that is laid over a portion of the

surface of the particle as required by claim 1. In contrast, Hu only teaches discrete nano-sized $\text{TiMn}_{1.5}$ particles on Mg composites. (See page 297 paragraph 2.)

Applicants teach and claim a unique magnesium-based hydrogen storage material with a continuous or semi-continuous layer of catalyst material on the hydrogen storage alloy. Applicants teach that this continuous or semi-continuous layer can be achieved through, for example, a coating process which includes evaporating the catalytic material to coat the hydrogen storage alloy at a thickness of about 100 Angstrom (page 6, paragraph 58.) By providing this very thin coating of catalyst material on the hydrogen storage alloy, cohesion of the catalyst material is sufficiently weak to allow the catalyst material to be spread across the surface of the hydrogen storage alloy, but the cohesion of the catalyst material is sufficiently strong to provide a continuous or semi-continuous layer. In contrast, Hu teaches producing alloys using reaction ball milling methods, and does not provide teaching how this method would form particles having a continuous or semi-continuous layer of catalytic material.

Since Hu does not teach each element of Applicants claim 1, claim 1 along with claims 4-9, 13-15, 17-22, which are dependent on claim 1, are non-obvious in view of Hu. Therefore, removal of the rejection is respectfully requested.

4. Rejection of Claims 1, 3-9, 13-15 and 17-22 under 35 U.S.C. 103 (a) over Oelerich et al. (*Metal Oxides as Catalysts for Improved Hydrogen Sorption in nanocrystalline Mg-based materials*)

Applicants traverse the Examiner's rejection over Oelerich, because Oelerich teaches neither a magnesium or magnesium-based hydrogen storage alloy, nor a

continuous or semi-continuous layer of catalytic material on the surface of the hydrogen storage alloy. Therefore, removal of the rejection is respectfully requested.

5. Rejection of Claim 16, under 35 U.S.C. 103(a) over Hjort

As discussed in section 2, Hjort does not teach or suggestions all elements of claim 1 in that it at least does not teach a hydrogen storage particle having a continuous or semi-continuous layer of catalytic material. Thus, claim 16 which depends on claim 1 is non-obvious over Hjort. Therefore, removal of the rejection is respectfully requested.

6. Rejection of Claim 3, under 35 U.S.C. 103 (a) over Welter et al in view of Sapru

As discussed in section 2, Welter does not teach or suggestions all elements of claim 1. Further, Sapru does not rectify these deficiencies. Therefore, claim 3 can all claims dependant thereon is nonobvious over Welter in view of Sapru.

7. Rejection of Claim 3, under 35 U.S.C. 103 (a) over Hu et al in view of Sapru

As discussed in section 2, Hu does not teach or suggestions all elements of claim 1. Further, Sapru does not rectify these deficiencies. Therefore, claim 3 can all claims dependant thereon is nonobvious over Hu in view of Sapru.

Applicants respectfully request withdrawal of all outstanding rejections and respectfully submit that the application stands in condition for allowance. If the Examiner has any questions or suggestions regarding this amendment, the Examiner is respectfully asked to contact Applicant's representative at the telephone number or email address listed below.

Respectfully submitted,

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